Northern Rhodesia.

Department of Agriculture

ANNUAL REPORT

for the year 1938

IMPERIAL MYCOLOGICAL
1 JULY 1939
INSTITUTE

Price: TWO SHILLINGS

LUSAKA:
PRINTED BY THE GOVERNMENT PRINTER.
1939.

4m—B735 5-39

DEPARTMENT OF AGRICULTURE.

STAFF LIST, 1938.

Headquarters :

C. J. Lewin, M.C., B.Sc.	Director.
R. O. Burton	Clerk.

Agricultural Staff :

W. Allan, B.Sc., A.I.C.T.A.	Entomologist, Mazabuka.
U. J. Moffat, B.Sc., N.D.D.	Agricultural Officer, Abercorn.
R. H. Fraser, B.Sc., A.I.C.T.A.	Agricultural Officer, Fort Jameson.
J. N. Clothier, Dip. Agric., A.I.C.T.A. ...	Agricultural Officer, Pemba.
C. E. Johnson, B.Sc., A.I.C.T.A.	Agricultural Officer, Pemba and Ecological Survey.
J. R. E. Hindson, B.A., A.I.C.T.A. ...	Agricultural Officer, Abercorn (Appointed 23-9-38).
R. H. Howard	Temporary Agricultural Assistant, Abercorn. (Appointed 1-7-38).
R. W. Mulliner	Temporary Agricultural Assistant, Fort Jameson. (Appointed 1-11-38).

Forestry Staff :

J. D. Martin, B.Sc.	Assistant Conservator of Forests, Machili.
C. E. Duff, M.A.	Assistant Conservator of Forests, Ndola.
R. G. Miller, B.Sc.	Assistant Conservator of Forests, Ndola.
G. R. Martyn	Forester, Machili.
J. L. A. Seward	Forester, Machili. (Appointed 16-6-38).
J. L. Lemmer	Forester, Ndola. (Appointed 24-6-38.)

Loan Staff :

C. G. Trapnell, B.A.	Ecologist.

Empire Cotton Growing Corporation Staff :

A. G. Bebbington, M.Sc.	Cotton Officer, Mazabuka.
R. M. Fowke, Cert. Agric.	Assistant to Cotton Officer.

Digitized by the Internet Archive
in 2025

https://archive.org/details/annual-report-department-of-agriculture-northern-rhodesia_1938

Northern Rhodesia.

DEPARTMENT OF AGRICULTURE.

Annual Report for the Year 1938.

AGRICULTURE IN THE TERRITORY.

1. The season 1937-38 was the driest of a succession of dry years and the distribution of the rain which fell was exasperating in the extreme. Late in arriving, the rains were almost continuous over the greater part of January, during which period field operations were greatly hampered. In most districts the rains ended abruptly in the middle of February, leaving backward crops to struggle through to maturity under conditions of extreme drought.

Maize.

2. In these circumstances, a substantial fall in maize production was inevitable, and the decline would have been even more marked had not the Mazabuka District been more fortunate than the remainder in receiving a few late showers. At Chisamba, hitherto a consistently productive area, the total and average yield was almost halved. In this area climatic troubles were augmented by an outbreak of " Army Worm " on farms to the east of the railway.

3. The nature of the season also accounted for a decrease in the acreage planted both to maize and green manures. Approximately 156,000 bags of European maize were surrendered to the Maize Control Board, a decline of 35 per cent. on the figure of the previous year.

4. The following is a comparative table of European maize production :

MAIZE PRODUCTION (EUROPEAN).

	Kalomo	*Maza-buka*	*Lusaka*	*Chi-samba*	*Fort Jame-son*	*Other Dis-tricts*	*Total*
1937-38 :							
Acres planted ...	939	14,031	17,114	8,326	221	1,474	42,105
Yield in bags ...	3,687	89,430	66,323	39,200	1,319	6,065	206,024
Yield per acre ...	3.9	6.4	3.9	4.7	6.0	4.1	4.9
1936-37 :							
Acres planted ...	997	14,442	18,840	8,985	81	1,054	44,399
Yield in bags ...	5,606	110,729	100,950	71,645	494	5,039	294,463
Yield per acre ...	5.6	7.7	5.4	8.0	6.1	4.8	6.6
Increase (+) *or Decrease* (—) *in* 1937-38 :							
Acres planted ...	—58	—411	—1,734	—659	+140	+420	—2,294
Yield in bags ...	—1,919	—21,299	—34,627	—32,445	+825	+1,026	—88,439
Yield per acre ...	—1.7	—1.3	—1.5	—3.3	+0.1	—0.7	—1.7

5. The amount of Native maize acquired by the Control Board was surprisingly high. The minimum domestic requirements of cultivators form a high proportion of the total crop, thus at low levels of yield no substantial surplus for sale can be expected. Actually 126,000 bags were sold, a remarkable figure for so bad a season, even though it represents a fall of 74,000 bags from the total of the previous year. It must be remembered, however, that in Mazabuka District where the bulk of Native maize is produced, the season was not wholly unfavourable. Moreover there is evidence that maize is now being brought in from districts too remote to attract the attention of traders in pre-control days. Six shillings per bag was paid for Native maize delivered at the Control Board's depots.

6. From a preliminary survey of Native Maize areas made during the year, it appears that the " average " Native unit consists of a man and his family cultivating six acres of maize. The family unit usually owns oxen and, more rarely, a plough and cultivator. These implements are hired if they are not owned. The average annual domestic requirements of the unit are 13 bags of maize and it is estimated that there are 17,000 units in the main maize producing areas. From these fundamental data an interesting calculation can be made :

Average yield in bags per acre.	*Surplus grain for sale per unit.*	*Total surplus grain for sale.*
2	Nil	Nil
2½	2 bags.	34,000 bags.
3	5 bags.	85,000 bags.
4	11 bags.	187,000 bags.
5	17 bags.	289,000 bags.

7. It will be seen that an average increase in yield of 1 bag per acre brings an additional 100,000 bags of Native maize on to the market provided that yields are in excess of 2.17 bags per acre, the minimum for domestic requirements. There has been at least one year, the disastrous season 1932-33, when yields were well below domestic requirements. In that season a combination of drought and locust damage reduced the European maize yield to 3.6 bags per acre and the Native crop on the whole was almost a complete failure. The season, however, followed a bumper year and large quantities of previously unsaleable maize were stored in the villages. This surplus not only prevented want, but was sufficient to provide a substantial quantity for sale in a season in which it was badly needed.

8. It might be feared that the ready market provided by the Maize Control Board would reduce surplus supplies in villages so that a disastrous season would involve shortage. It is quite possible that this fear may yet be realised locally, if not generally, even though Maize Control has caused considerable increase in acreage. However, there can hardly be any question of famine in this normally prosperous area and if, in some years, surplus cattle have to be traded for grain, a shortage of maize would not be wholly disadvantageous, for the Reserves are rapidly becoming overstocked.

Wheat.

9. Not since the bumper crop of 1935 have wheat farmers enjoyed a good season. This is particularly disheartening as the crop is normally a remunerative one and, in the quantities which can be produced on existing land, it sells readily. During the last two years, acreage has been halved on account of water shortage, and the small acreage planted this year was affected by a severe attack of Wheat Aphis (*Toxoptera graminum*). There is no satisfactory remedy for this pest, which is normally kept in check by natural parasites. It is not improbable that the outbreak may be symptomatic of worked-out and eroded lands. There is much to be learnt about the management of wheat lands under local conditions, and it appears possible that the Department may at last be in a position to make the necessary investigations.

10. The recent history of wheat production is summarised in the following table :

Year	*Acreage*	*Total Crop*	*Mean Yield*	*Remarks*
1934	2,845	12,564	4.4 bags	An average year.
1935	3,234	18,228	5.6 bags	A record year.
1936	4,249	11,121	2.6 bags	Severe rust damage.
1937	2,524	5,504	2.2 bags	Water shortage.
1938	1,822	5,021	2.8 bags	Water shortage and Aphis.

Groundnuts and Beans.

11. In spite of the scheme for encouraging production of groundnuts and beans, the Territory is still far from self-supporting. The ruling prices offer no inducement to European farmers but increased Native production would be advantageous in every way. The season was a poor one for both crops, particularly for groundnuts, and there was some falling off in the quantities available for sale. It is only possible to ascertain the quantities of local produce exported or offered to the mine contractors ; no information as to the extent of the store and market

trade is available. From ascertainable figures it appears that the scheme has so far been instrumental in disposing of over 3,000 bags of nuts and beans per annum, and there is reason to believe that this quantity very largely represents new production. The most spectacular advance of the year was made in Serenje District where, thanks to the initiative of the District Officer and the co-operation of the contractor, over £600 was distributed among growers from the sale of beans which formerly had no cash market at all.

Potatoes.

12. As with maize, the acreage under potatoes fell owing to unfavourable planting conditions. Yield was also poor, particularly in the Pemba-Choma region which normally produces the biggest and best crops. Only 2,800 bags were available for sale, the lowest quantity for several years.

Tobacco : Eastern Area.

13. With some relief to reader and author we can now turn to the one bright portion of an otherwise gloomy story. For some time Fort Jameson planters have been slowly recovering from the slump which occurred ten years ago. This year their persistence was rewarded. The season was at first unfavourable, but a sudden change improved conditions so much that a record crop of high quality tobacco was cured. In addition, prices were maintained at a reasonably high level and the district is at last enjoying modest but well earned prosperity. It is gratifying to record that the increase in estate income is reflected by improvement of buildings and agricultural practice and in increased purchases of fertilizer.

14. The total number of registered tobacco growers is now 80 in the eastern area. There was no immigration of new settlers during the year, but some former residents have returned from employment elsewhere and some young men are now setting up on their own account. Certain estate managers are, however, new comers.

15. Voluntary auction sales were continued and the quantity passing over the floors increased from 292,000 to 780,000 lbs. The average price realised was approximately 6*d*. per lb. for auctioned tobacco which is mainly exported overseas. Tobacco sold for the " protected " African markets naturally realised much higher prices, and it is estimated that the average for the entire crop was 9.3*d*. per lb. for unpacked leaf at Fort Jameson, equivalent, this year, to a gross return of over £18 per acre.

Tobacco : Western Area.

16. In the railway belt the subsidy to the Tobacco Co-operative Society for the provision of advisory services is bearing fruit. The output was nearly doubled and, on the whole, the quality of leaf was improved. Approximately half the crop was sold very profitably under the quota. The disposal of the balance, which consisted mainly of the lower grades, proved difficult. Approximately 27,000 lbs. were offered on the Salisbury Auction floors, but for a number of reasons this project was a failure, and the tobacco was subsequently withdrawn and shipped overseas on consignment.

17. The following is a comparative table of flue cured tobacco production :—

VIRGINIA TOBACCO (FLUE CURED).

	Western Area	*Eastern Area*	*Total*
1937-38 :			
Acres planted	226	3,680	3,906
Yield in pounds	113,000	1,883,000	1,996,000
Yield per acre	500	512	511
1936-37 :			
Acres planted	121	3,355	3,476
Yield in pounds	45,000	1,142,000	1,187,000
Yield per acre	372	340	341
Increase in 1937-38 :			
Acres planted	+105	+325	+430
Yield in pounds	+68,000	+741,000	+809,000
Yield per acre	+128	+172	+170

In addition, 58,000 lbs. of sun cured leaf were produced in the Eastern Area and 12,000 lbs. of Turkish leaf in the Railway Belt.

Coffee.

18. At Abercorn a further 90 acres of coffee were abandoned and 5 acres were planted. The present position is :

Acres bearing	251
Acres not bearing	95
Acres newly planted	5
Total	351

414 cwt. of hulled coffee were produced, an average yield of only 185 lbs. per bearing acre.

19. The Abercorn Co-operative Society produced both pure coffee and coffee and chicory mixture, roasted and ground in sealed tins. The society staged a most attractive display at the Kafue Show in July.

Locusts.

20. The Territory again escaped serious locust damage. The only species in evidence was *Nomadacris septemfasciata*, the Red Locust. There was little local breeding, though flying swarms were recorded at one time or another from most districts.

21. Hopper bands were confined to restricted areas of Mwinilunga, Broken Hill and Petauke districts. In Broken Hill district some damage to European crops was caused by active hopper bands in the later stages. Flying swarms caused some damage to dry season Native gardens and to citrus and deciduous fruit trees.

22. During May and June there was a considerable westerly migration of young flying swarms which probably originated partly from local hatchings and partly from neighbouring territories. Some of these young swarms were of unexpected size and density. Scattered swarms continued to be reported in diminishing numbers throughout the remainder of the year. During the last three months very few were recorded.

THE WORK OF THE DEPARTMENT.

23. During my absence on leave from February until October the department was ably administered by Mr. W. Allan, Entomologist.

24. Forestry continued to be administered as a sub-department. The year's work is recorded in Part II of this report.

25. The staff of Agricultural Officers was increased by one when Mr. J. R. E. Hindson arrived in October on transfer from the Gold Coast. Messrs. R. H. Howard and R. W. Mulliner were appointed as temporary Agricultural Assistants in July and November respectively.

26. The year was one of transition from the maintenance rations of the past to the full fare to be provided under the " Five Year Plan " in 1939. As an aid to a digestive system unattuned to liberality, the Native Development Board made stimulating advance contributions. These enabled an immediate start to be made on certain projects which were long overdue, and permitted the engagement of the two Agricultural Assistants.

27. The funds granted by the Native Development Board for projects limited to 1938 were as follows :

	£
Temporary appointment of Agricultural Assistant (Eastern Province)	137
Chiteme Control (including temporary appointment of Agricultural Assistant)	581
Temporary housing for Agricultural Assistant (Eastern Province)	55
Native Tobacco Experiments (Petauke District)	60
Development of Beeswax production	562
Additional expenditure at Kanchomba Agricultural Station ...	90
Forest Survey of Barotseland	150

Ecological Survey.

28. The Ecological Survey of Northern-Eastern Rhodesia was continued. Field work has now been completed except for that required to cover the area roughly enclosed in the triangle Mkushi-Serenje-Petauke, and to link up the eastern and western portions of the soil and vegetation map of the whole Territory.

Agricultural Shows.

29. His Excellency the Acting Governor opened a Native Agricultural Show at Kateya (Reserve XIII) in June. The departmental exhibit consisted of models and pictures illustrating causes and effects of erosion on the one hand and the benefits of anti-erosion measures and sound farming practice on the other. In the erosion panorama the inclusion of a model skeleton of an ox lying in a donga was possibly more responsible than anything else for creating a healthy atmosphere of consternation among the numerous spectators. The department is indebted to Mrs. Campbell and to Mr. Martin Morris for kind assistance in the preparation of models and pictures. Simply constructed scotch carts were exhibited by the Zambesi Saw Mills Ltd., and by the department, and demonstrations of cotton ginning and beeswax making were arranged.

30. Apart from a slight *contretemps* caused by failure on the part of the cattle classes to share the spectators' evident appreciation of the regimental band, the show was a great success. The number, quality and variety of entries exceeded all expectations.

31. For several years the department has been unable to stage an exhibit at the Kafue Show, for its experimental work in the railway belt has been confined to Native agriculture since the closing down of the agricultural side of the Mazabuka Research Station. This year, however, the departmental exhibit at Kateya was re-constructed at Kafue at the request of the show committee.

Flue Cured Tobacco.

32. No new experimental work was initiated at the Fort Jameson station during the year. Accumulated evidence indicates that the rotation *Tobacco* : *Tobacco* : *Sunnhemp* : *Maize* is satisfactory under local conditions, provided that both tobacco crops are fertilised and that the sunnhemp is cut and composted, the compost being applied to the maize land. This rotation has succeeded in maintaining both yield and quality of tobacco for the last eight years on a field which has been cropped continuously since 1927. It should be added that the field has been protected by broad-based terraces since the Department took it over in 1931. A similar rotation in which sunnhemp is ploughed under instead of being composted proved satisfactory for six seasons, but the land is now showing signs of declining fertility.

33. A new field was opened during the year for subsequent fertiliser trials.

Native Grown Tobacco.

34. Last year trials of *Western* fire cured and sun cured and of *Burley* air cured tobacco were initiated at Mvuviye in Petauke District in order to explore the possibility of developing a Native tobacco growing industry. In addition to a departmental plot of 4 acres, there were 9 half-acre plots cultivated by individual volunteers. The experiment was an encouraging and useful one. Seven of the growers tended their crops well and realised an average of £2 2*s*. 8*d*. from the sale of their leaf. This naturally stimulated interest in a district devoid of cash crops, and 54 Natives have established plots under departmental supervision in the current season. From experience gained in the former year, it has been decided to concentrate on air cured *Burley* of the " Stand Up " type.

Coffee.

35. The manurial trials with coffee at Abercorn were re-arranged to provide information on the effects of vegetable mulch, compost and Nicifos singly and in all combinations. Due to the change in certain of the treatments the year's results have yielded little new information. The most striking indication was obtained from the " mulch only " plots. Hitherto these have maintained a healthy condition and in the first year of cropping they yielded fairly heavily. This year they showed unmistakable signs of exhaustion ; yields were low and die-back pronounced.

Much better showing was made by the " mulch plus compost " plots. These results were confirmed by a minor trial with 9 year old coffee in which " mulch plus compost " proved a far more economic treatment than either " mulch " or " compost " alone.

36. As there is still some difference of opinion as to whether irrigation is or is not necessary under local conditions, it seems desirable to record departmental experience in this matter in some detail. The first coffee plots to be established at the Abercorn station were divided into two series, irrigated and unirrigated. These were all sited on red soil which is typical of some estates, though it is now known to be rather an unfavourable medium. For the first three years of cropping the plots received no manurial treatment. During this period the irrigated series produced small crops and maintained as satisfactory a condition as could be expected in the circumstances. The unirrigated series produced no crop at all, and steadily declined in condition. Both series were then divided into four and the following treatments were started :

Control (No treatment.)
Mulch.
Compost. (10 tons per acre.)
Mulch plus 10 tons Compost.

37. Since then, two crop seasons have been completed. The unirrigated series have still failed to produce a crop worth picking, though there has been marked improvement in the condition of the trees which have been mulched, particularly with those which received mulch plus compost. The yields from the irrigated series were as follows :

Average Yields per Acre (lbs. Clean Coffee).

	1937	1938	*Average*
Control	238	229	234
Mulch	446	441	444
Compost	376	538	457
Mulch plus Compost ...	488	797	643

Again the " mulch " and " compost " plots improved in condition.

38. There can be little doubt that on these soils irrigation is absolutely essential, and this is borne out by experience on at least one private estate. It is possible that the need for irrigation may not be so marked on other soil types, particularly if the coffee is well mulched, but up to the present no really satisfactory yields have been obtained without irrigation anywhere in the district. Quite apart from the question of its necessity, irrigation promotes a single flush of flowering and crop setting, whereas reliance on rainfall usually results in double flowering and its attendant nuisance at harvest.

39. From present information, the Department can only advise new comers not to open up estates unless ample irrigation water can be made available, and it must urge caution to those existing planters who hold that irrigation is unnecessary.

40. The control measures advocated for white borer have now been in operation on the station for five years. During this period, borer infestation has steadily declined from the initial figures of 90 per cent. in older coffee and 40 per cent. in young trees to a negligible figure of less than 1 per cent. throughout.

Cotton.

41. Cotton work in Native areas continued on the lines indicated in previous reports but on a larger scale. Improvement in yield was recorded in all areas, due partly to better cultivation and land selection but also to a much lower incidence of *Dysdercus fasciatus*. The reason for the comparatively mild attack of this stainer, as compared with the exceedingly heavy attack of last season, was shown by the records of wild host plants. Though a very large population was bred up on *Thespesia rogersii*, it was not forced to migrate from the trees until considerably later in the season and consequently the F2 generation on *Hibiscus asper* was small.

Cotton in Plateau Regions.

42. Two series of observation plots were planted, one on the Kanchomba station and the other on an adjacent farm, with a view to making preliminary

selections of types more suited to the high elevations. Considerable differences were observed in the behaviour of strains and some gave very satisfactory yields. The average yield of all strains was 416 lbs. seed cotton per acre.

43. These yields contrast with the average of 120 lbs. per acre obtained from Native grown plots in the neighbouring part of Reserve XI, where again the tendency to utilise worn-out land and to neglect cultivation was marked. On the northern border of the Reserve more care was taken to select suitable land, and cultivation was better. In this area the average yield was 264 lbs. of seed cotton per acre, staining was slight, and on several plots yields exceeding 500 lbs. per acre were obtained.

44. The people of the Kalomo Plateau, while apparently willing enough to plant cotton, again showed little inclination either to plant it on reasonably good soil or to cultivate it. Though some good yields were obtained in this area, the average was only 115 lbs. of seed cotton per acre.

45. In Mumbwa District there was again considerable variation both in the care and attention given to the crop, and in the yields for the three areas in which trials are being conducted. These were :

	Highest Yield	*Average*
Nalusanga	480 lbs.	210 lbs.
Chibuluma	717 lbs.	181 lbs.
Mumbwa	420 lbs.	159 lbs.

As in former years, moderate but satisfactory yields were obtained on the light " Mutondo " soils, while the more variable but on the whole more fertile " transitional " soils gave much more variable yields and a lower average.

Cotton in Valley Regions.

46. The trials in the Marambo area of the Luangwa Valley, initiated and conducted by the Agricultural Officer, Fort Jameson, again gave very good results indeed. Forty-five growers put in cotton over a total of 27 acres. In spite of a fairly heavy infestation of Red Bollworm (*Diparopsis castanea*), an average yield of 608 lbs. of seed cotton per acre was obtained with a maximum yield of 1,200 lbs.

47. This area appears to be very well suited to cotton, but strict adherence to general uprooting of the plants after harvest will be necessary to prevent increase in Bollworm population. Considerable progress has already been made in the destruction of perennial kidney cotton bushes.

48. The plots at Nyimba in Petauke District gave fairly good yields, the average being 270 lbs. of seed cotton per acre, but staining was heavy. In view of the lack of enthusiasm of the people in this area, the scarcity of trained Native assistants and transport difficulties the trials have been discontinued.

49. Preliminary trials were commenced in the Kalomo area of the Zambezi Valley at the end of 1937. Thirty-three growers planted gardens of varying size amounting in all to 14 acres. The average yield was 272 lbs. of seed cotton per acre and the maximum 628 lbs. Planting was generally late, three-quarters of the plots being planted very late in December, and yields of some plots were depressed owing to lack of cultivation. The results therefore definitely indicate that the valley may be suited to cotton cultivation, but considerable further investigation is required before cotton growing can be encouraged on any scale, for there exists the danger of heavy stainer attack and the rainfall is generally low and apparently extremely variable.

The Future of Cotton Growing.

50. The ability of cotton to produce a crop is now fairly clearly defined in the areas in which trials have been conducted, but prices still remain low and the market outlook is uncertain. Nevertheless some degree of development appears to be warranted.

51. The valley areas, as one would expect, are most suited to the crop and in the two large valleys of the Luangwa and the Zambezi a cash crop is badly needed. In the Luangwa Valley yields are high enough to offset low prices, and gradual development may be embarked upon without undue risk ; but in the Zambezi Valley further trials must be carried out to ascertain the effect of a fickle rainfall.

52. On the plateau region of the railway line cotton is required mainly as a rotation crop. Since it will yield some return it should be more readily adopted than one of purely rotational value. At present prices, however, cotton is generally considerably less remunerative than maize and the tendency is therefore to plant it on soils which will not give a reasonable return from maize. Development of cotton growing, in conjunction with general improvement in agricultural methods, is therefore likely to be slow.

53. The position in Mumbwa District is rather different. The need for a rotation crop is less marked than that for a cash crop. Unfortunately yields are only moderate and long haulage is involved. The outlook hardly warrants development, but the Provincial Administration was anxious that the work should not be discontinued. With the approval of the Native Development Board it has been decided, therefore, to continue to pay $\frac{3}{4}d.$ per lb. for clean seed cotton delivered at Mumbwa Boma. If any loss is incurred through this arrangement it will be made good by a subsidy. The latter, if needed at all, will not be large and in all probability will be more than covered by indirect revenue resulting from the circulation of money in this district.

54. In November the future of cotton growing was discussed by the Native Development Board and a grant of £2,556 was made to cover development in valley and plateau areas over a period of three years. The grant includes provision for the purchase at fixed prices of the anticipated crop during the next three years. A substantial portion of the grant will therefore be refunded from the proceeds of sales.

Beeswax.

55. Exports of beeswax declined sharply from the record set up in 1937, partly on account of a poor season and partly because of a temporary fall in market prices. Considerable fluctuations in beeswax production must be expected. The causes of fluctuation are obscure, but there appears to be some correlation of wax production with rainfall and the flowering of major " bee trees." The effect of the comparatively recent encouragement of the beeswax industry is clearly shown in the following table :

Exports of Beeswax

Year	*Cwt.*	*Declared value* £
Average 1928-33 ...	12	40
1934	6	22
1935	73	270
1936	500	1,999
1937	997	3,839
1938 (11 months)... ...	445	1,256

56. With the object of obtaining detailed information on swarming and wax and honey production, some preliminary experimental work was carried out at Mumbwa. Observation hives were established and continuous records were made by a trained Native Assistant, who was also responsible for training Demonstrators. Swarming occurs throughout most of the year, but there is a well defined peak from October to January. This is illustrated in the following table which shows the number of hives occupied each month as a precentage of empty hives at the beginning of the month. The number of empty hives at the beginning of each month was maintained at fifty.

Month	*Percentage of hives occupied*
October	10
November...	26
December	14
January	10
February	4
March	4
April	2
May	2
June	4
July	10
August	Nil
September...	Nil

57. A series of 15 hives, put up in October and occupied in late October or November, were examined in June, following the Mutondo (*Isoberlinia paniculata*) honey-flow, when the bulk of the comb was removed leaving what was thought to be sufficient to maintain the colony. The hives gave an average yield of exactly 1 lb. of clean good quality wax. Two of the hives were deserted after removal of the comb. The occupied hives were again examined in December after the late-season honey-flow, and it was found that only a relatively small quantity of wax, approximately 7 ozs. per hive, had been produced.

58. Rough records of hive occupation were also made on a large scale throughout the district. These show a low percentage of occupation due partly to weak swarming, partly to the fact that the great bulk of the hives were put up after the period of active swarming and partly to failure to smoke the hives.

59. Training courses for instructors were held at Mumbwa, Abercorn and Fort Jameson, and a number of trained instructors and demonstrators were supplied to each province. They will work in the areas most promising for beeswax development under the direction of the District Commissioners.

60. A pamphlet on the cleaning and marketing of wax was distributed to traders. This pamphlet was written by Mr. ffoliot Fisher, and based on his ten years experience in developing a beeswax industry in Mwinilunga District.

Cultivation of Dambo Fringes : Lunzuwa.

61. The object of the dambo fringe experiments is to ascertain how cultivation of this type ot soil may be developed as a supplement to the traditional " chiteme " of large parts of the Northern Province. The experiments are designed to provide information to enable a satisfactory rotation to be formulated, in which " Male " (*Eleusine coracana*) figures as the staple crop. The rotational effects of various crops and the practicability of composting are being investigated. The two main problems in this type of agriculture are the maintenance of soil fertility and control of weeds. Maintenance of soil fertility presents little difficulty as far as the prevention of erosion is concerned, as cultivation is exclusively by hand, but in the building up of the soil the difficulty arises that " male " land cannot be dressed with ordinary manure owing to weed introduction. Well made compost may solve this problem if the labour involved is not prohibitive. Weed control is an exceedingly difficult matter as the staple crop is broadcast and is almost indistinguishable from the allied weed *Eleusine indica*. It may well be that the ultimate solution of both problems will be found in long period grass fallows, a reversion, in fact, to traditional Native practice, but if means can be discovered whereby the normal period of cultivation can be extended, substantial progress will have been made.

62. Most of the experiments are of recent origin and have still to yield results. The following indications have been obtained from the older trials :

(*a*) Considerable increases in yield of " male," varying from 20 per cent. to 90 per cent., are obtained from applications of 10 tons of compost per acre.

(*b*) When properly made, compost does not introduce weed seeds, but it encourages vigorous growth of those already present in the soil.

(*c*) 20 tons of compost per acre nearly trebled the " male " yields in one experiment, but applications of this order would be impracticable in Native agriculture.

(*d*) " Male " must be rotated with a cleaning crop on account of weed encroachment.

(*e*) Sweet potatoes seem to be a better rotation crop than beans.

Chitemene Experiments (*Lunzuwa*).

63. These experiments are designed to assess the advantages of burning of typical " chiteme " soils and to ascertain how, and for how long, these poor soils can be made to yield economically. Those experiments which have been in existence sufficiently long to yield results show very clearly why burning is so popular. Each trial started with alternate plots of " male " after normal burning and after mounding. Thereafter a rotation crop was grown on mounds throughout and in the

following year " male " (unburnt) was planted on the flat. Three years of cropping have been completed on Block A, two on Block B and one on Block C. The results are summarised in the following table :

" Male " Yields per Acre (lbs. on Head).

Block	*Year of Harvest*	*Plots Burnt in First Year*		*Mounded Plots*	
A	1936	1,616		Failure	
	1937	Beans and Groundnuts			
	1938	*After Beans*	*After Nuts*	*After Beans*	*After Nuts*
		1,824	1,128	640	352
B	1937	2,552		1,168	
	1938	Beans and Groundnuts			
C 1	1938	2,944		1,526	
C 2	1938	2,800		1,424	
C 3	1938	2,624		1,144*	

* Two plots destroyed by game.

64. It will be seen that " male " crops obtained immediately after burning were double, or more than double, those obtained without a burn. The effect of burning somewhat surprisingly persisted in Block A for three years, for in the third year quite satisfactory yields were obtained and these were treble the yields of similarly cropped plots which had never been burnt. The cropping on all blocks will be continued until the " male " crops fail.

Controlled Chiteme Scheme.

65. It would be foolish, if not impracticable, to attempt to bring about a sudden transition from chiteme (lopping and burning) to more orthodox methods of " male " culture. All experimental evidence goes to prove that chiteme is the most reliable system of agriculture on the poorer soils of the North-Eastern Plateau, and it is the traditional system of a people who regard the axe rather than the hoe as the indispensible agricultural implement. Chiteme is frequently stigmatized as " primitive " and " wasteful," but a " primitive " system which has the advantage of reliability over any alternative needs no justification, and the criticism of wastefulness would have more force if any other use for these poor woodlands could be found. Uncontrolled chiteme can, however, be disastrous where there is local shortage of woodland and it is to these areas, which occur notably in Abercorn Reserve V and in Isoka Reserve XI, that attention must be paid.

66. Clearly the most immediate solution of the problem of overcrowded chiteme areas is to be sought not in a drastic change of agricultural method but in an organised scheme of village cutting combined with protection of the regenerating bush. This would eliminate avoidable waste and would also remove one of the objections to the chitemene system, the constant moving of villages. Its adoption would go a long way toward the preservation of congested areas pending the gradual utilisation of the better soils for " male " under more orthodox methods of cultivation.

67. A scheme on these lines was prepared by Mr. Moffat last year. Briefly it consists of distributing villages in such a manner that each may be allotted a cutting area adequate to support its chiteme on a reasonable scale in perpetuity. The total village area is subdivided into 15 to 24 annual blocks which are cut in rotation. Regeneration of cut blocks will be ensured by fire protection under the early burning system

68. With the aid of a grant from the Native Development Board, it was possible to initiate this scheme in the Mambwe (Nsokolo) Reserve V during the year. Early in the course of the preliminary investigations it was found, as had long been suspected, that the forested area of the Reserve was totally inadequate even for an organised scheme of cutting. Happily the difficulty was removed almost as soon as it arose. The Tanganyika Estate, in which Reserve V is embedded, was purchased from the British South Africa Company and at the end of the year permission was granted for the demarcation of 35 village areas in land adjoining the Reserve.

69. By the end of the year, the following progress had been made :

(*a*) Active propaganda, which was begun in 1937, was intensified.

(*b*) Every village in the Reserve, a total of 130, was visited at least twice by the Agricultural Officer.

(*c*) The sites for 79 villages were fixed with the consent of the chiefs and inhabitants.

(*d*) Thirty-five village areas were selected and defined on the map, and a further 19 were also demarcated on the ground.

If no hitch occurs it should be possible, with the augmented staff now available, to complete the demarcation of all the village areas before the 1940 cutting season begins (June 1940).

70. Although everything so far has gone smoothly, it must be realised that the critical period has not yet been reached. This will begin when the annual cut of each village is restricted to the block allocated for the purpose. No serious friction is anticipated, but no immediate success can be claimed for the experiment until this critical period has been passed, and during it close supervision is obviously essential. The ultimate success of the scheme will, of course, also depend on the accuracy with which the village areas have been assessed. No allowance has been made for increase of population. It is considered that the gradual development of subsidiary gardens, cultivated on the better soils by more orthodox methods, should enable food production to keep pace with consumption.

71. The Agricultural Officer was greatly assisted in the preliminary work of estimating the required areas of woodland of different types and in devising fire protection methods, by a visit from the Assistant Conservator of Forests, Ndola.

Course for School Teachers (Lunzuwa).

72. In August the Agricultural Officer held a fortnight's course in school gardening at Lunzuwa. The course was attended by 12 teachers, the majority of whom have now put their newly acquired knowledge into practice in a most gratifying manner. The course included instruction in the selection of land, lay-out, prevention of erosion and the cultivation of common vegetables and fruit trees.

Shiwa Experiment Station.

73. This station was generously provided by Lt.-Col. S. Gore-Browne, D.S.O., M.L.C., and Mrs. Gore-Browne kindly acts as an honorary Agricultural Officer in charge of the work. No experimental results can yet be recorded as the first year's cropping was devoted to a uniformity trial with " male ". Satisfactory uniform plots have been selected for subsequent work.

Kanchomba Experiment Station.

74. This station was opened in 1936 in a corner of the Tonga (Magoye) Reserve XI, about 12 miles from Pemba. The main objects of the station are to ascertain the means whereby the fertility of the valuable maize soils of the Railway Belt may be maintained, and to serve as a focus for the dissemination of such methods as may be found to be advantageous and practicable. The three main lines of work are—

(*a*) the prevention of erosion ;

(*b*) the development of a sound and acceptable rotation embodying maize as the main cash crop ;

(*c*) the introduction of manuring or some simple system of composting.

75. The first year of cropping (1936-37) was devoted mainly to uniformity trials. The second year has given a few interesting indications, but a good deal of trouble has been caused by excessive soil variation. Maize grown on land treated with 6 tons compost per acre gave higher but not significantly higher yields than that from untreated land. Somewhat surprisingly, the effect of previous crops of cotton and groundnuts was significantly greater than that of compost. The

rotation effect of these crops may well be ephemeral but this has yet to be determined. The results of the experiments are summarised below. In each case "control" indicates uncomposted maize following a previous uncomposted maize crop.

Block	*Treatment and Yield*		*Yield of Control*	*Remarks*
I	Maize (composted) ...	922	714	Light land. Difference not significant.
II	Maize after cotton ...	1,092	643	Light land. Difference significant.
III	Maize after groundnuts	1,722	994	Medium land. Difference significant
IV	Maize interplanted with cowpeas.	1,168	1,131	Good land. Difference negligible.
V	Maize (composted) ...	1,898	1,502	Good land. Difference not significant.

Yields are expressed in lbs. per acre throughout. It was hardly surprising that there was no difference between maize interplanted with cowpeas and maize alone. The interplanted cowpeas were excessively shaded by the maize crop and the stand was poor

76. Although much has yet to be learnt, it was obvious from a survey of Native maize areas that certain simple improvements could safely be made in current practice without awaiting experimental results. Shallow ploughing down slopes and continuous cropping with maize is rapidly reducing the fertility of the soils in Native gardens, and it was considered advisable to demonstrate without delay that improvement is well within the capabilities of the Native farmer.

77. For this purpose a local villager, one Kalebe, was selected and trained for one year at Kanchomba. He was then employed as a demonstrator on his own garden some four miles from the station. His garden is approximately six acres in extent and lies on gently sloping land which showed signs of sheet erosion. It is surrounded by similar gardens and may be taken as typical of holdings on reasonably good soil of the transitional type. The garden was divided into four sections by contour ridges, a superior three roomed cottage was provided and a few fruit trees were planted. Thereafter the demonstrator and his family were left to work the holding in accordance with the provisional rotation scheme: *Maize* (manured or composted); *Maize* (unmanured); *Cotton and groundnuts*; *Maize interplanted with cowpeas.*

78. The first year's results exceeded all expectations. The season was a poor one and maize in neighbouring gardens can hardly have exceeded 3 bags per acre. Kalebe's garden is stated to have "stood out like an island in a sea of poor crops." His yields were:

Crop	*Yield per acre lbs.*
Maize (manured)	1,871
Maize (unmanured)	1,001
Maize interplanted with cowpeas	622
Groundnuts (shelled)	900
Cowpeas	65

The outstanding features were the 9 bag yield of maize from the manured plot, the exceptionally high yield of groundnuts and the failure (confirmed by results at Kanchomba) of maize interplanted with cowpeas. The interplanting of cowpeas will now be discontinued.

79. During this first year ordinary kraal manure was applied as no compost was available. If weeds were introduced they were kept in check by good cultivation. There is no reason at present to presume that compost has any greater effect on yields than have scrapings from open kraals and its manufacture involves considerable labour. On the other hand, a much larger quantity can be made from the same number of cattle and, where the kraal is near a dwelling, there is the great advantage of cleanliness and freedom from flies. Compost is now being made by the simplest of methods on the demonstration garden. The littered kraal floor is dry (under normal conditions the mud would be belly deep), there is no smell and no flies are harboured.

80. One further point of interest if not of significance, out of some 200 entries the demonstrator won the first prize for maize at the Kateya Show. One hastens to make the usual disclaimers. He was unaided in the selection of cobs, and the judges were local farmers who were unaware of his identity.

81. From successful demonstration to the general adoption of improved methods is a far cry. All that can be claimed at the moment is that the demonstration excited considerable interest, that the system adopted is apparently successful, and is not beyond the capabilities of any man and his family, and that the department is justified in establishing a number of similar gardens within an area which can be adequately supervised from Kanchomba as a preliminary to serious extension work in the reserves.

Anti-erosion Work.

82. While no large schemes aimed directly at the control of erosion could be embarked upon, a good deal of preliminary work was accomplished. In February a memorandum embodying a general appreciation of the position was submitted to Government. In this it was argued that for the time being the major activities of the department should be concentrated on the areas most in need of protection (the maize growing areas of the railway belt, the Tanganyika Estate Reserves and some of the reserves in the Fort Jameson district), even at the expense of other important work. The recommendations were generally accepted and preparatory work was initiated in each area.

83. As a preliminary to the drawing up of a protection scheme for the railway belt reserves, a survey of Reserve XI was started. Native gardens were mapped over an area of 60 square miles and notes were made on the action required to protect them. It soon became evident, however, that an extension of this work to the 3,000 square miles of land embracing the most important maize areas would involve dangerous delay, and would be quite beyond the resources of the existing staff unless all other work were to be abandoned. It was thought that air survey could supply most of the information required within a few months, and negotiations for such a survey were in progress at the end of the year.

84. Reference has already been made to the experimental introduction of a scheme for chiteme control in the Tanganyika Estate. If this is successful the problem of preserving overcrowded chiteme areas will have been solved. In this region, also, simple protection banks are being tried in some villages which, through shortage of trees, have been forced to adopt digging in lieu of burning for " male " crops. Here cultivation is exclusively by hand and crops are grown on mounds and on the flat in alternate years. Protective banks roughly along the contours can be rapidly made by joining up mounds. If these banks are planted instead of being thrown down in the following year they should afford protection to the crops grown on the flat, especially if minor adjustments are made to their alignment. The system adopted is a rough and ready one as no levelling instruments are used, but gardens are small and more latitude in the alignment of banks is permissible than with those designed for the protection of large areas. The result of the trials will be followed closely. If they are successful the system should be capable of application to most areas in which hoe cultivation is the exclusive practice, for a small trained staff, working in co-operation with villagers, can cover an astonishingly large amount of country in the course of a season.

85. In the absence of an adequate staff the exceedingly difficult problem of dealing with congested reserves in Fort Jameson district could receive little attention. The worst of these areas were surveyed by the District Commissioner and Agricultural Officer and proposals were put forward for the provision of more land where this appeared to be the only solution. It was intended that immigrants to new areas should be required to cultivate in accordance with simple instructions. The land has not yet been made available and the highly desirable adoption of the proviso will involve considerable increase in departmental staff. In the meantime, every opportunity of stressing the advantages of good cultivation and the prevention of erosion has been taken in those areas in which the department is endeavouring to develop the production of economic crops. In the Marambo cotton area there are already signs that insistence on sound cultivation of cotton plots is having a salutory effect which is by no means confined to cotton. The layout of new Native tobacco

plots at Mvuviye was most praiseworthy, and if the high standard can be maintained there seems to be little cause for fear that the introduction and development of an economic crop will be made at the expense of the soil.

86. When proceeding on leave in February I was able, through the courtesy of the Resident Commissioner and the Director of Agriculture, to study the progress of the soil erosion campaign in Basutoland and to form some idea of the extent to which similar work could be instituted in our maize growing areas. On my return from leave I was also able to see something of the pasture reclamation work in the Union through the courtesy of the Chief, Division of Plant Industry.

Advice on Tobacco Soils.

87. The Nyasaland Government kindly made the services of Captain Hornby, Assistant Director of Agriculture, available for advice on tobacco soils. Captain Hornby inspected the Native tobacco trials at Mvuviye and toured the railway belt from Kalomo to Broken Hill. His report was most valuable and encouraging. The prospect of developing a small air cured *Burley* industry at Mvuviye was considered favourable. The reconnaissance of the railway belt showed that there were considerable stretches of eminently suitable land for bright flue cured tobacco.

Advice on Coffee at Abercorn.

88. In October, Mr. S. M. Gilbert, Chief Scientific Officer of the Coffee Research Station, Lyamungu, kindly paid a visit to Abercorn to inspect the Coffee Station and private estates. Mr. Gilbert was accompanied by Mr. Stent, Soil Chemist (formerly a member of this Department) and Mr. F. W. Thomas, Agricultural Officer, Tanganyika Territory. Mr. Gilbert endorsed the lines on which departmental work is proceeding and, in addition, made suggestions with regard to pruning. Neither he nor the Soil Chemist were particularly favourably impressed by the soils of the majority of coffee estates and stressed the necessity for liberal manurial treatment. This opinion is fully substantiated by there sults of manurial trials at the Station.

Conferences.

89. While on leave, I attended a Conference of Directors of Agriculture at the Colonial Office and the third conference on Cotton Problems convened by the Empire Cotton Growing Corporation. Mr. Allan represented the Territory at a grass fires conference in Southern Rhodesia.

LEGISLATION.

Tobacco (Sales by Auction) Ordinance, 1938.

90. This Ordinance, which applies only to the Eastern Area, provides for the compulsory sale of tobacco by auction. It is a logical development from the success of the voluntary auction sales held at Fort Jameson since 1936, and was introduced at the request of planters in the Eastern Area. The control of auction sales is vested in the Eastern Tobacco Board. For the time being the provisions of the Ordinance are confined to flue cured tobacco.

Tobacco Marketing and Levy (Amendment) Ordinance, 1938.

91. Under this Ordinance, provision is made for the expansion of the personnel of Tobacco Boards from four to six members, and nominees of buyers and exporters of tobacco may be included in addition to nominees of growers. The maximum rate of levy is also increased from 6*d.* to 8*d.* per 100 lbs. of leaf exported.

Maize Control (Amendment and Extension) Ordinance, 1938.

92. Certain minor amendments were made and the operation of the Ordinance was extended to the 31st May, 1939.

Maize Control (Amendment) Regulations, 1938.

93. These regulations were confined to amendments in the procedure of the registration of traders.

REVENUE AND EXPENDITURE.

94. The recurrent expenditure of the Department, exclusive of Forestry and Ecological Survey and of the grants received from the Native Development Board, but including the entire administrative charges, has been roughly as follows in recent years :

	1933(*a*)	1934	1935	1936	1937	1938
Administrative and Clerical ...	£2,100	£1,500	£1,500	£1,500	£1,500	£1,600
European Officers Employed	3	2	2	2	2	2
Field Work	£7,400	£3,000	£4,000	£5,000	£6,000	£7,400
European Officers Employed	11	3	3	4	4	5
Total	£9,500	£4,500	£5,500	£6,500	£7,500	£9,000
Total European Officers Employed	14	5	5	6	6	7

(*a*) The financial year of 1933 was one of nine months. The figures included are estimates based on the whole year.

95. Revenue is naturally small. In 1938 about £500 was received from the sale of agricultural produce, and a contribution of £500 towards the cost of the cotton experiments was made by the Empire Cotton Growing Corporation. In addition, the Corporation again seconded one of their officers for work in the Territory. Their continued assistance is most gratefully acknowledged.

PART II.—FORESTRY.

96. The main features of the year were the welcome increase of European staff by the addition of two Foresters, the satisfactory progress made in the training of Native staff, the success of fire control operations in the *Baikiaea* forests of the Southern Division and the preparations for the establishment of a Native Forest Service in Barotseland.

97. The European staff was posted as follows :

J. D. Martin, Assistant Conservator : On leave, January-March. Southern Division, April-December.

C. E. Duff, Assistant Conservator : Northern Division, January and February. On leave, March-December.

R. G. Miller, Assistant Conservator : Northern Division, January-December.

G. R. Martyn, Forester : Southern Division, January-July. On leave, August-December.

J. L. A. Seward, Forester : Southern Division, June-December.

J. L. Lemmer, Forester : Northern Division, July-December.

98. The Native staff consisted of 32 Forest Rangers and Guards and 1 Clerk in the Northern Division, and 11 Forest Rangers and Guards in the Southern Division plus 15 Forest Rangers and Guards employed in the Sesheke forests and paid from the Barotse Forest Fund. In the Southern Division 5 apprentice Forest Rangers were also received for training.

DEMARCATION OF FOREST RESERVES.

99. Three Forest Reserves in the Northern Division were gazetted during the year These are :

Kafulafuta Forest Reserve : A watershed area of 139 square miles established for protection purposes.

Songe-We-Lala Forest Reserve : 36 square miles of medium quality forest near road and railway, 50 miles south of Ndola.

Katanino Forest Reserve : 22 square miles of good quality forest near the railway, 60 miles south of Ndola.

100. The following amendments to Forest Reserves were made :

Broken Hill Fuel Reserve : A convenient area of 1 square mile was added.

Chondwe Forest Reserve : This small but high quality Reserve was cancelled and was incorporated in the new Kafulafuta Forest Reserve.

Mindola Fuel Reserve : An area of 50 acres was excised to provide land required by Kitwe Township.

INDUSTRIES AND EXPLOITATION.

The Zambezi Saw Mills.

101. During the year, timber (mainly *Baikiaea plurijuga*) was extracted by the Zambezi Saw Mills Ltd., under the Sesheke and Yeta's Forests Agreements. The former agreement came into operation last year and imposes a rate of royalty in lieu of the flat annual rental charged under the latter. From the revenue which accrues under the Sesheke Agreement, £750 per annum will be paid during the period of the lease to the Barotse Native Treasury and the balance will be funded to provide for the preservation of the best of the forests.

102. The Company worked at full pressure throughout the year, employing 99 Europeans and 4 136 Natives. The exploitation of the remainder of Kanyanga and Nanga Forests (Sesheke lease) was completed in May, and cutting was then resumed in the southern portion of Lonze Forest (Yeta's Forests lease). By the middle of 1939 exploitation under Yeta's Forests lease will have been completed and operations will then be diverted to the Simungoma-Katimo Mulilo area. In anticipation of this, the construction of a logging line was begun in March and by the end of the year the Machili River had been bridged and 44 miles of track had been laid.

103. Kanyanga and Nanga Forests gave a yield much in excess of expectations. Their combined area is but 10 square miles yet a total of 2,848,000 cubic feet of timber was extracted from them, a yield of approximately 450 cubic feet per acre. This is exceptionally high for this type of forest and has been excelled only in the better parts of Lonze Forest, which is believed to contain the finest areas of *Baikiaea* forest in existence. In Lonze, Kanyanga, Nanga and in parts of the Simungoma Forest, *Baikiaea* reaches its finest development. To the east and west of these areas the forests degenerate into woodland.

104. Despite the high yield of Kanyanga and Nanga, the royalty which accrued amounted only to approximately 12*s.* per acre. This compares favourably with the yield of 2*s.* 6*d.* per acre received from equally good forest under Yeta's Forests lease, but revenue is not likely to accrue at an average rate of 12*s.* per acre from the remainder of the Sesheke forests.

105. The volume of timber, in the round, extracted by the Zambesi Saw Mills during the course of the year was as follows :

From Kanyanga and Nanga Forests	1,286,400 cubic feet.
From Lonze Forest	2,160,890 cubic feet.
Total	3,447,290 cubic feet.

The output of sawn timber was :

Railway sleepers (Rhodesia Railways) ...	557,587 cubic feet.
Railway sleepers (South African Railways) ...	350,140 cubic feet.
*Parquet blocks, strips and flooring	69,734 cubic feet.
Other timbers	236,515 cubic feet.
Total	1,213,976 cubic feet.

* Of this, 17,500 cubic feet were exported overseas.

Mining Timbers : *Northern Division.*

106. The bulk of local mining timbers are taken either from privately owned land or free of charge from mining locations and Crown Land. In these circumstances it is only possible to estimate annual consumption very roughly. 24,000

cubic feet of *Isoberlinia* and *Brachystegia* sleepers were cut on payment from Crown Land near Chondwe. The Roan Antelope Mine cut some 100,000 cubic feet of poles from their own property for use underground, and Nkana Mine used about 100,000 cubic feet of large poles in the refinery. Of this latter quantity, roughly half was taken free of charge from Nkana Area C Forest Reserve, and the remainder from mine property. 30,000 cubic feet of poles, cut near the Congo border, were sold to Kipushi Mine.

Furniture and Joinery Woods: Northern Division.

107. The following timbers were cut under licence from Crown Land:

Pterocarpus angolensis (Mulombwa, Mukwa),...	7,000 cubic feet.
Afzelia quanzensis (Mupapa) and *Albizzia antunesiana* (*Musase*)	3,500 cubic feet.
Isoberlinia tomentosa (Mutobo) and *Erythrophloeum africanum* (Kaimbi)	14,000 cubic feet.

In addition, some 5,000 cubic feet of various species were cut by Native sawyers working in the vicinity of townships.

Firewood: Northern Division.

108. Annual consumption of firewood, other than domestic consumption by rural Natives, is estimated at 50,000 cords (6½ million cubic feet). Of this quantity some 15,000 cords were sold from Forest Reserves and Crown Land. This total includes, *inter alia*, 2,000 cords cut departmentally in the course of clearing Forest Reserve boundaries, 1,500 cords exported from Kapako to Kipushi Mine and 2,100 cords sold from Lenje Reserve fuel area near Lusaka. The sale from the Lenje Reserve was made on Government instruction and represents twice the estimated annual yield of this area. Accordingly, 1,000 cords will be considered as an advance sale of the 1939 yield and no further coupes will be offered for sale until 1940. The balance of firewood consumed (estimated at 35,000 cords) was cut by the Mining companies either on their own land or free of charge from Crown Land.

EXPORTS AND IMPORTS.

109. The following tables show the value (in country of origin) of the exports and imports of wood and manufactures thereof during recent years.

EXPORTS.

	1932	1933	1934	1935	1936	1937	1938
	£	£	£	£	£	£	£
Unmanufactured ...	9,674	11,634	20,903	25,964	31,498	40,167	
Partly manufactured	73	309	1,245	2,247	776	3,347	
Joinery	514	347	79	138	110	545	*
Furniture	9,256	6,222	1,039	428	996	733	
Other manufactures ...	3,858	4,538	1,351	1,677	1,937	2,410	
Railway Sleepers ...	17,826	31,291	39,557	74,476	107,633	101,059	
Totals	41,201	54,341	64,174	104,930	142,950	148,261	176,264

* Details not available.

IMPORTS.

	1932	1933	1934	1935	1936	1937	1938
	£	£	£	£	£	£	£
Unmanufactured ...	29,293	29,264	41,294	24,392	35,679	58,034	
Partly Manufactured ...	2,304	2,646	2,754	2,666	1,482	5,052	
Furniture	9,527	8,375	12,867	9,642	7,890	17,909	*
Joinery	4,232	1,867	4,202	4,167	2,873	11,264	
Other Manufactures ...	6,137	5,940	10,632	4,492	6,003	14,241	
Totals	51,493	48,092	71,749	45,359	53,927	106,500	111,610

* Details not available.

REVENUE AND EXPENDITURE.

110. Revenue and expenditure for the past eight years have been as follows :

Year	*Gross Revenue*	*Expenditure* *
	£	£
1930-31	850	1,854
1931-32	417	2,740
1932-33	423	2,997
1933 (9 months)	316	2,366
1934	693	2,298
1935	1,040	3,540
1936	1,345	3,250
1937	1,789	3,595
1938 (estimated)	1,860	4,670

* No share of the cost of administrative headquarters of the joint departments is included in the table of expenditure.

111. In addition, expenditure on the Barotse *Baikiaea* forests, which are to be exploited under the Sesheke lease, has been met from the Barotse Forest Fund. The fund is at present overdrawn due to the fact that expenditure was incurred before any appreciable royalties accrued. Royalty receipts will be much larger from 1940 onwards when the exploiting company's activities will be confined to the Barotse forests. The present position of the fund is as follows :

	Revenue	*Expenditure*
	£	£
1936	19	1,346
1937	2,079	1,387
1938	1,764	1,354

DIVISIONAL OPERATIONS : SOUTHERN DIVISION.

Introduction.

112. The Southern Division, which covers Barotseland and that part of Northern Rhodesia south of the Kafue, has an area of approximately 92,000 square miles.

113. In the past, forestry activities have been mainly confined to the *Baikiaea* forest region in the Livingstone, Sesheke and adjoining districts. The time of the limited staff was taken up with the reconnaissance of the *Baikiaea* forests, the supervision of large scale exploitation, the protection from fire of all the valuable and potentially valuable *Baikiaea* forests and the development of communications between the forests. European staff was confined to one Assistant Conservator until July, 1935, and thereafter to one Assistant Conservator and one Forester.

114. The reconnaissance of all the accessible and many of the remote *Baikiaea* forests has now been completed, Native staff have been trained in protection and control of exploitation, and nearly all the larger forests have been linked up by motor roads. As the staff is being augmented by a second Forester it is now possible to contemplate the extension of activities to a much wider field.

115. As far back as 1935, when a scheme of forest protection by the Native Authorities was drawn up and applied to Sesheke District, the extension of similarly organised forest protection to the rest of Barotseland was hoped for. The project was supported by the report of the Ecological Survey, draft Native forest laws were formulated, and the Assistant Conservator attended two District Commissioners' Conferences at Mongu to discuss these laws and other forestry matters. The training of apprentice forest rangers was begun with the object of having a nucleus staff available for Barotseland when the opportunity for extension arrived.

Reconnaissance and Touring.

116. Aided by a grant from the Native Development Board, the Assistant Conservator began a tour of Barotseland in September with the object of establishing a Native Forest Service in each district. The main aim had not been achieved by the end of the year owing to delay in approval of draft forest laws by the Paramount Chief and Council, but much preliminary work was accomplished in the study of

local problems, the selection and training of Forest Indunas and in explaining the proposed forest laws to large gatherings of Natives. The Assistant Conservator was accompanied by the District Commissioner, Mankoya, and the District Officer, Mongu-Lealui during portions of the tour. The co-operation of the Provincial Administration throughout the course of this work is gratefully acknowledged.

117. Kataba Forest on the Mankoya-Sesheke border will be exploited in about five years time. To investigate the possibilities of further forests in that region, a three weeks' tour was made of the Luampa-Lumbe-Njoko-Machili-Kafue watersheds in Mankoya District and the adjoining areas of Senanga and Namwala Districts. 320 miles of compass and cyclometer traverse were made on foot, and topographical and vegetation maps were prepared. The sources of the Lumbe, Luampa and Musa Rivers were fixed, but no forests likely to influence the future of exploitation were found.

118. The investigation of the forests of the Dongwe and Kabompo Rivers in northern Mankoya, northern Lealui and southern Balovale Districts was next undertaken. 200 miles of traverse were made on foot and maps were prepared. Owing to the unsettled political situation, reconnaissance of Balovale District was confined to a short inspection of the forests adjoining the Zambezi, Lower Kabompo and Lower Lungwebungu Rivers. A report on the value of these forests was supplied to the Balovale Commission.

119. Eight weeks were spent touring northern Lealui District between the Lusaka-Mongu Road and the Kabompo River, and the adjoining area of northern Kalabo District. It was found that the existing maps were not sufficiently accurate to serve as a basis for plotting forests and vegetation, and the preparation of a new 1/250,000 map was undertaken. In an area of approximately 3,000 square miles, all forest and woodland regions were visited and mapped and 27 forests were selected for reservation.

Enumeration, Sylviculture and Regeneration.

120. The Forester carried out a chain and compass traverse of the main extraction lines and rides in Yeta's forests area. The information gained was added to the Survey Department map of the boundaries, in order to serve as a basis for stock mapping.

121. The 2½ per cent. enumeration survey of Situmpa Forest was completed with the exception of 4 square miles of unexploited forest at the northern end and 3 square miles of exploited forest at the southern end, where work was stopped in order to enable a survey of the fire-damaged areas of Lonze Forest to be completed.

122. A stock map of 12 square miles of Situmpa Forest was made. This showed that the area consists of three forests joined by belts of dense *Pterocarpus stevensonii* (Mwangula), *Acacia giraffae* (Muhoto) mutemwa. The northern area is the most valuable, having an average of 95 *Baikiaea* poles of good quality per acre, while the exploited southern areas have an average of only 5 poles per acre. Regeneration is good in the northern, but patchy in the southern areas. The latter have been severely damaged by fire in the past, and few of the younger age classes were present when they were exploited in 1930-33. Since, at that time, there was no control over felling, very few seed-bearers remain over large areas, and complete natural regeneration will never be obtained. In 1931 it was noticed that most of the poles and older trees in the southern areas were stag-headed. This was attributed to several seasons of low rainfall. The trees have now partially recovered and are forming good crowns.

123. A 2½ per cent. enumeration survey of 14 square miles in the northern part of Lonze Forest was completed. This area suffered severely from the disastrous fires of 1937. The survey of the remaining 28 square miles will be completed in 1939.

124. The effects of the 1937 fires on Yeta's forests area were carefully studied. It was found that the fires which occurred in Situmpa Forest at the beginning of 1937 dry season had not done much serious damage. The fires had burnt in patches only, regeneration in the burnt patches had been burnt back but had sprouted again from the deep taproots. Pole growth near burnt heaps of slash and crown-wood (left after exploitation) was badly scorched though still living, while all poles

actually in the burnt heaps had been killed. On the other hand, large quantities of slash had been got rid of, and regeneration from seed, which fell after the fires, was growing strongly on the fertile ash patches. The enumeration survey lines were re-opened and a further enumeration of the burnt areas will be carried out at a later date when injured poles have had a chance to recover or die, in order to see what permanent damage has been done.

125. Lonze Forest, which suffered severely from a late fire in 1937, presented a different picture. At first sight it appeared that one-third of the forest might have to be written-off as totally destroyed. The worst fires occurred in the northern and recently exploited part of the forest.

126. In the 14 square miles to which reference is made in paragraph 123, fire damage was confined to just under eight square miles, six square miles having escaped unscathed. In the damaged zone the average number of poles was found to be 7 per acre. Of these an average of 2 were undamaged, 2 were damaged but alive and 3 had been killed. Many islands and groups of poles had escaped completely, and regeneration was profuse throughout the burnt and unburnt areas. Even where the intense fire from great heaps of slash and branchwood had burnt back seedlings to a depth of 6 inches, the seedlings had come away again from the taproots and were growing vigorously in the fertile ash. Fortunately the fire occurred just before seedfall and regeneration from the seeds shed after the fire by the dying trees was found to be abundant. Disposal of slash and adequate regeneration have therefore been obtained at a price.

127. Instead of being abandoned, the burnt areas will be carefully protected to preserve the regeneration and the remaining poles, and to encourage the undergrowth which sprouts readily even after repeated burning. Until the undergrowth is tall enough to check the abundant grass growth, fire danger will be a serious menace.

128. The following conclusions have been drawn from a study of the effects of fires :

(*a*) Intensive fire-protection with adequate patrolling is essential in exploited forests near densely populated areas. It is not safe, however large the labour force available, to rely on being able to extinguish late fires before great damage has been done.

(*b*) Early fires in exploited areas retard regeneration but only destroy pole growth which is surrounded by slash.

(*c*) Late fires in exploited forests destroy pole growth unless the undergrowth is thick and the grass consequently sparse. They do not, however, destroy regeneration, though repeated firing probably would.

(*d*) Both early and late fires dispose of large quantities of slash and are beneficial to this extent, but they themselves create a certain amount of slash by burning down large Mwangula (*Pterocarpus stevensonii*) trees.

(*e*) Some means of slash disposal will have to be found. As long as the slash is present there will always be a danger of great damage when a fire does occur.

129. The greatest amount of slash accumulates in the best areas of forest where most timber has been obtained, and consequently these areas suffer most heavily when fire occurs. All crown and branchwood is now pulled back from within 6 feet of living trees by the felling Company, but this regulation was not in force when Situmpa and northern Lonze were exploited. While the new regulation will decrease fire damage it will not afford sufficient protection *Baikiaea* is a heavily branched tree and the piles of crown and branchwood are, in places, six feet high. Funds have been voted for slash disposal in 1939. and the best areas of pole growth will be tackled first. Over 15 square miles of forest, however, are turned into slash heaps every year.

130. Eight sample plots were laid out in exploited and unexploited forest for the study of rates of growth and of regeneration.

131. No further trials of taungya were carried out as there is at present no demand for fresh forest for cultivation. Lack of population adjoining most of the forests is a serious handicap to the extension of this means of regeneration, but what population there is presents a problem. There are always enough Natives

to cause fires but seldom enough to put them out. There are enough to have destroyed large areas by shifting cultivation in the past, but not enough to ensure the regeneration of the large areas of poorly stocked forest by the taungya system, and never enough to provide an adequate supply of labour for forest work. Some system of forest settlements would be of great benefit, but the obstacles to this seem to be insuperable.

Fire Protection.

132. As in 1937, the rains finished early and there followed a long fire season from April till the end of November. Unlike 1937, however, fire-protection was with one unimportant exception completely successful, chiefly owing to a great increase in the number of patrols in Yeta's forests, and to the departmental protection of Lonze forest on behalf of the lessees who refunded the cost of this work.

133. In Livingstone District, out of a total area of 224 square miles of exploited and unexploited *Baikiaea* forest under protection, only Mapanda Forest, 10 square miles in area, suffered from fire. Mapanda was the first *Baikiaea* forest to be exploited, and having been abandoned for many years before being protected it is more or less worthless. Little further damage was therefore done. The offender was caught by the local forest induna and was fined by the local Native Court.

134. In Sesheke district some 260 square miles of forest were successfully protected and no fires occurred. So far, only 10 square miles of this area have been exploited and fire danger is therefore less than in the exploited forests of Livingstone District.

135. Stringent measures, in which the Directors of the Zambesi Saw Mills co-operated wholeheartedly, were taken to protect Yeta's forests. Of a total area of 104 square miles, some 90 have been exploited and are highly inflammable. The Zambesi Saw Mills logging camp, sawmill and compounds of over 1,000 Natives are situated in the centre of the area, between the four forests. The large logging compound is on the edge of the largest forest through which over 1,500 Natives go to and from their work daily. The Company's cattle kraals are strung out round the forests, hunters enter the forests daily, there are numerous stores and small settlements of loafers and hangers-on and a constant stream of Natives enters and leaves the area, mostly along paths through the forests and old extraction lines. It will, therefore, be appreciated that the problem of fire protection is one of some magnitude.

136. Under the terms of the lease the exploiting company is responsible for the protection of the forest in which it is working. This arrangement proved unsatisfactory in 1937 when the disastrous fires were undoubtedly due to faulty protection. By arrangement, therefore, the Department took over the protection of areas under exploitation and the cost of the work was refunded by the Company. The other forests were protected at departmental expense.

137. Work on fireguards was begun early in April, and continued until the beginning of September. Lonze was divided into 14 and Situmpa into 10 blocks by wide internal fireguards. 18 Forest Guards and three Fire Watchers were stationed on the boundaries and in the middle of each forest. Daily patrolling was instituted and motor traffic was prohibited along all fire guards. Honey hunting was prohibited in the forests during the danger season and a close watch was kept on the movements of hunters. Numerous minor outbreaks found by the patrols were extinguished before they could spread. Two honey hunters, who had made fires and failed to keep them under control, were caught shortly after leaving their fires, prosecuted and fined.

Plantations.

138. Some 50,000 Mukwa (*Pterocarpus angolensis*) pods were collected for sowing in the Livingstone Nursery. Various methods of treating the seeds before sowing were tried in order to improve germination, which has been very low in the past. The best results were obtained with seeds extracted from the pods and soaked in cold water for 24 hours before sowing. Pods chipped to expose the seed and soaked for 24 hours before sowing also gave good results.

139. A site for trial plantations was cleared on the sand ridge behind Livingstone and a series of plots were planted with root and shoot cuttings of 3 year, 2 year and 1 year old Mukwa seedlings from the Nursery. 100 per cent. take and survival was obtained, and unless the older seedlings show marked superiority in subsequent growth and survival, root and shoot cuttings of one year old seedlings only will be used in future, thus saving space and attention in the Nursery.

Roads.

140. The forest roads were maintained in good condition. Many miles of old extraction lines were opened up in Situmpa and Lonze Forests to serve as internal fireguards and inspection motor roads. Gates were erected at the entrance to two fireguards in Situmpa Forest to keep out unauthorised motor traffic. A road was made across the Machili into the southern end of Lonze Forest, to make the logging operations more accessible from headquarters.

141. A deviation of three miles was made on the Sesheke-Katima Mulilo Road to avoid a patch of loose sand which had given trouble. With the assistance of the District Commissioner, Sesheke, 19 miles of road were made to Nanga Forest, sandy crossings of the Kanyimba and Sichili Streams being found and drained. The road was then continued beyond Nanga towards Kataba Forest on the Njoko River. Thirty miles were cleared permanently and a track was opened up for the remainder of the distance. From Kataba Forest to Mankoya Boma, a dry season track following Native paths was opened up with the assistance of the District Commissioner, Mankoya. Ninety miles of this track were completed at a cost of £10.

DIVISIONAL OPERATIONS: NORTHERN DIVISION.

Introduction.

142. The Northern Division nominally covers nearly 200,000 square miles and includes the whole Territory with the exception of Barotseland and the larger part of the Southern Province. Little or no forestry work is in progress except near the railway line. Even within that strip operations are mainly concentrated around the seven townships of Lusaka, Ndola, Broken Hill, Luanshya, Kitwe, Mufulira and Chingola, which are by far the largest centres of population and of industrial activity. The last five of these towns owe their existence to large mines, of which that at Broken Hill alone has been in operation for more than 10 years, and that at Chingola is still in the early stages of development. The other two are administrative and business centres. The population of these seven towns ranges from under 1 000 Europeans and 5,000 Natives to over 2,000 Europeans and 20,000 Natives. Lusaka lies some 90 miles south of Broken Hill, and a distance of 130 miles to the north separates the latter from Ndola and the copper mining towns, which are grouped only 20 to 50 miles apart on the "Copperbelt". The rural population of Natives in the railway strip has for the last 10 years been resident in Native Reserves which approach the railway and the townships at only a few points.

143. The railway strip north of the Kafue is extensively wooded and the main townships can be pictured as isolated clearings in a wide extent of bush. This picture is least accurate at Lusaka, where stretches of *Acacia* tree-grassland represent typical European farming land. From Broken Hill northwards, *Brachystegia-Isoberlinia* woodland covers most of the country. Normally a rather thin and short growth, this woodland reaches an average height of 50 feet in parts of the Copperbelt. Only in limited areas, however, is timber of sawable dimensions present in reasonable quantity, and species with first quality timber are of even more restricted occurrence. Much of this woodland has been cleared in the past for Native cultivation, and many of the present stands are of coppice origin.

144. In the Native Reserves the people still find the bulk of their needs in the forests, and the exploitation of fertility accumulated under tree growth is the basis of their agricultural methods. Demands on the forests are, in general, so widely scattered that even the low average productivity of the bush is not severely taxed except in a few localities where an undue concentration of population has resulted since the establishment of the Reserves. The Forests Ordinance does not apply to Native Reserves and few of the Native Authorities have any forest rules of their own. The people take their requirements from the forest as and

how they will, but the forests could seldom be used for any better purpose. Certain of the more crowded areas would benefit from simple measures of forest protection. Such measures have recently been proposed for some areas but are not yet in force.

145. Commercial demands for timber originate almost entirely from the towns. Common to all of them is the need for firewood, which is the only domestic fuel of both Europeans and Natives, and is used for many industrial purposes. The mining companies also use considerable quantities of large sized timber, of which they import stocks to an average annual value of over £50,000, principally of such better class softwoods as Douglas Fir and Pitch Pine. Ignorant handling of Native timber and subsequent failure resulted in a strong prejudice against it during the early years of mining. In spite of its defects of size and quality, local timber, especially when given preservative treatment, can meet many mining needs. Most of the mines have now overcome this first prejudice, and local wood is now being used to the extent of 300,000 cubic feet per annum, principally in the form of poles. One mine has a special need for straight trunks over 16 feet in length and 12 inches girth, and the same company draws its supplies of railway sleepers from a local source.

146. Most of the copper mines could maintain their requirements of the smaller classes of timber and firewood from their extensive land grants. They have however allowed great wastage to take place in the past, and it is not yet certain what part Government will have to play in assuring future supplies of these products. A company which requires large-sized poles has already foreseen a shortage of this class of timber and has decided that a plantation programme offers the best solution.

147 Other consumers of timber are mainly dependent on Government areas for their supplies. There is little likelihood of their being faced with an absolute shortage of either firewood or small poles. On the other hand, as yields are low and transport rates are high, there is every prospect that the costs of procuring these products will rise steeply if the reaily available resources are not protected. Indiscriminate clearing has greatly reduced these resources in the past, but this wastage has now been checked. Near each of the townships, Forest Reserves have been, or shortly will be, established in order to guarantee, by conservative working, the perpetuity of conveniently situated supplies.

148. Reference has already been made to the scarcity of saw timber. Trees of suitable dimensions occur in economic quantity only in scattered patches of taller woodland, characterised by *Isoberlinia tomentosa* and *Erythrophloeum africanum*. In this type *Pterocarpus angolensis*, a timber of outstanding value, reaches its best development. These scattered forests support a joinery and sleeper industry at Ndola, and a small trade in wooden furniture handled by numbers of individual Natives. Wherever areas of such forest, large enough for economic management, have been found on unencumbered Crown Land, they have been declared Forest Reserves.

149. The greatest obstacles to a comprehensive forestry programme lie in the facts that large areas of the best and most conveniently situated forest on the Copper Belt are on land which is controlled by the mining companies, and that over still wider areas these companies can, in certain circumstances, take timber free of royalty or any other conditions, under rights incorporated in the Mining Proclamation. Thus the largest consumers of local timber make no direct contribution to the expenses of the administration, and the existence of these rights has introduced so much uncertainty that the adoption of any long-range plans of forestry work has been almost impossible.

150. During the six years since an Assistant Conservator was first posted to this division, it has been staffed by an average of one European officer. A Native staff of 32 Forest Rangers and Guards has now been built up and trained in the elements of forestry work. Through the Native staff, working in co-operation with District Commissioners, an organisation has been developed to control wood-cutting on all Government areas around the townships. All wood-users are controlled by the department, and this closer supervision has greatly increased the amount of revenue collected. Forest reserves for firewood and timber production and one extensive protection forest have been established, and the immediately essential essential boundaries have been demarcated. Much time has been devoted to botanical investigations, and to experimental work in the utilisation, regeneration and sylviculture of the indigenous tree species. Trials with many exotic species, especi-

ally Pines (which might meet the natural deficiency of softwood timber), and in fire-protection methods have also been carried out. Early-burning is now widely practised in areas under the control of the department. With recent increases it European staff it is hoped that it will now be possible to extend activities further afield to make more practical use of the data collected from experiments and to administer more closely the areas under departmental control.

Organisation.

151. The organisation of the Forest Rangers and Guards for the protection of forest reserves and Crown Land and the control of all wood-cutting activities was greatly advanced during the year. As is always necessary in the early stages of a forestry programme, the subordinate staff is at present almost exclusively a protective force. Even this stage has only been reached as the result of a period of selection and training spread over the last 3 years. A considerable step forward became possible when the post of Forest Ranger was place in Class I of the Native Civil Service at the end of 1936.

152. The duties of Forest Guards are generally confined to forest reserves, where they have to see that a relatively simple list of prohibitions is enforced. In addition to their daily patrols, they have also to supervise labourers employed in boundary clearing, road construction, early-burning, etc., and the operations of licencees working in reserves. Few of these Guards have had more than one year of schooling, but most can write, at least very badly, in the vernacular. They are all able to record by simple methods the numbers of cords of firewood or poles which may be cut by licencees, but few of them can measure timber in the round.

153. The Rangers are mostly drawn from men who have reached Standard IV at school, and further enlistments will only be made from youths who have passed Standard VI. This means that they can speak and write English fairly fluently, and have a knowledge of arithmetic and general subjects almost equal to that of an English elementary school boy. This standard had to be somewhat lowered at the start in order to obtain older men who could immediately undertake the considerable responsibilities of their posts. The better educated youths now being recruited will have to serve a longer apprenticeship, not only until they have acquired a sense of responsibility but also until they have picked up the bush lore which so many of them fail to acquire during their years at school.

154. The Forest Ranger now stationed at each of the seven main townships is generally responsibile for all forestry work within his area. Forest Rangers have to supervise and assist the Guards stationed in forest reserves, and are directly in control of undemarcated forest, where the legal provisions in regard to tree cutting are more complicated. They assist in the issuing of licences and check by measurement all saw-timber which is cut. A standard form of report is submitted monthly. These men are being trained in elementary surveying and nursery work, and have already proved of great assistance in the laying out of cutting areas and the demarcation of boundaries. Three Rangers are employed exclusively in checking the quantities cut by concessionaries.

155. In the absence of a European officer at any of the townships except Ndola, the District Commissioners assist in the routine supervision of the Native staff. This supervision is necessarily limited, and further progress is dependent on more frequent supervision and on the granting of wider powers to both European and Native members of the department. The authorised addition of two European Foresters to the staff will help to provide the former and enable more works of management to be undertaken.

Reconnaissance and Touring.

156. The only detailed reconnaissance undertaken during the year was in the vicinity of Chingola. This resulted in proposals for a forest reserve to be established along the Kafue River in order to afford protection to natural amenities. At both Chingola and Luanshya the establishment of forest reserves for firewood production is held up pending the settlement of land matters.

157. During a four weeks tour of the Northern Province, which had not been visited by a Forestry Officer within the previous seven years, such matters as the control of grass fires, the protection of river headwaters, and the possibilities of a gum trade were briefly investigated. Native Reserve V in the Abercorn District,

where the local Agricultural Officer has started a scheme for the control of shifting cultivation in combination with agricultural improvement works, was also inspected. This scheme amounts to an elementary working plan regulating, on a sustained yield basis, the area of bush which may be cleared annually for gardens ,and incorporating simple measures to encourage the regrowth of forest. In this connection advice was given as to a suitable rotation, methods of early-burning and other practical details.

Forest Protection.

158. Early burning was carried out in 90 square miles of forest reserve and 15 square miles of exploited areas on Crown Land, and was highly successful in preventing damage to young regrowth by late fires. The Native staff is gradually acquiring familiarity with this work, and is becoming more efficient in its practice. The maintenance of complete fire protection is almost impossible, but extensive early burning is already yielding the favourable results previously obtained on an experimental scale .The organisation of early buring operations requires to be more intensively developed.

159. Although the Forests Ordinance is now much more effectively enforced than it was a few years ago, the position is not thoroughly satisfactory. Hitherto very few prosecutions have been undertaken as, with the staff available, it has proved impossible to secure adequate evidence for conviction. Offenders have usually been required only to pay royalty, and exhorted to follow the correct procedure in future. This cannot continue indefinitely to serve as a deterrent, and more rigorous measures are now needed to maintain the control which has already been secured. These measures will require that a greater part of the time of the European staff be devoted to such matters, unless the handling of offences can be simplified by alteration of the present law.

Management of Forest Reserves.

160. Sixty miles of external boundary lines were maintained. The undefined boundaries of Chichele Forest Reserve, a length of 7 miles, were demarcated. A further 6 miles of survey was carried out to complete the boundaries of Ndola West and Mindola Forest Reserves, and an additional 3 miles of the boundaries of Mufulira Forest Reserve were defined. Of the total of 359 miles of boundaries of effective forest reserves, 254 miles (*i.e.*, 71 per cent.) are now defined on the ground. This percentage, however, includes all natural boundaries, whereas the demarcation of the remaining 29 per cent. will, in every case, involve survey and the cutting of lines.

161. Apart from early burning, the only sylvicultural work yet undertaken in forest reserves has been the thinning out of coppice regrowth in firewood areas cut more than 3 years ago. This was carried out in all coupes of that age at Lusaka, covering some 500 acres, and was begun over a similar area at Broken Hill at the end of the year.

162. No detailed stock maps of forest reserves have yet been prepared. Timber reserves have so far only been put under protection, but most of the reserves devoted to fuel purposes are already in the production stage. In these areas only a general reconnaissance has been carried out, and a figure for the sustained yield has been determined from conservative estimates of the growing stock. For the planning of operations to the best purpose more accurate data are urgently needed, and at Lusaka and Broken Hill preliminary survey work has been started.

163. Ten miles of additional car tracks were constructed in forest reserves. Existing compounds were kept in repair and three more small compounds were built at Chichele, Mindolo and Nkana Area C Forest Reserves. A rest hut was also built in Mufulira Forest Reserve.

Experimental Work.

164. The early buring and fire protection plots were treated according to plan. The results previously reported are annually becoming more apparent. Consistent annual late burning is turning the two clear felled plots from woodland into grassland ; consistent early burning has already brought their twin plots into the tall thicket stage.

165. In the Nursery, germination of indigenous species was again good, except for *Entandrophragma caudatum*. Seeds were sown in beds, in drills three inches apart. 1,000 Plants of each of the six principal species were also put out in nursery lines from the seed beds where they had been growing for a year. An innovation was the raising of 1 year × 1 year × 1 year Nursery stock of indigenous species, in order to provide carrot-like stumped plants for next season.

166. In the field trials, spot sowings repeated the experience of last year. *Afzelia quanzensis* and *Erythrophloeum* can be relied upon to give the best results in most seasons and in most circumstances. Tenth acre plots were successfully planted with two year old stock of seven indigenous timbers, *Albizzia* sp. (near *A. versicolor*) and *Trichilia emetica* being the only new introductions.

167. The pines, now well infected with mycorrhizal fungus, continued to flourish. *P. patula* grew rapidly. *P. caribaea*, *P. taeda*, *P. teocote*, and to a less extent, *P. longifolia* grew steadily and kept good colour. Only *P. radiata* (*insignis*), *P. muricata* and *P. halepensis* showed serious die-back of the leading shoots in the dry season. Six acres were planted at the end of 1938, all in the form of test plots with detailed records. Cheaper methods of preparing the ground were tried and weeding was reduced. New species planted included *P. montezumae*, *P. apacheca*, *P. ponderosa*, *P. coulteri*, *P. leiophylla*, *P. echinata*. These were raised in seed boxes, pricked out into cheap clay tubes and planted about nine months after sowing, in the middle of the rains.

168. At Matonchi, on the Angola frontier in Mwinilunga District, four further plots were established by Captain Paterson. Some open-rooted transplants were bundled and sent successfully from Ndola through the post ; a 300 miles journey which took a fortnight. They included *P. muricata*, *P. engelmanii*, *P. ponderosa*, *P. montezumae*, *P. patula*, *P. pinea* and *P. pinaster*. At Matonchi *P. patula* attained 10 feet in its two years of growth and *P. radiata* grew to 8 feet in the same time. Small pilot plots of Pines and Eucalypts were established at Nkana Area C and Chichele Forest Reserves at the end of the year.

Utilisation.

169. The routine annual inspection of the graveyard test of the durability of indigenous timbers and of the effectiveness of simple preservative salts against termites was made. The results noted were in accordance with those which have been previously reported.

Botany.

170. The herbarium was brought up to date early in the year, but a considerable number of recent additions accumulated in later months. Eighty-one identifications were received from the Imperial Forestry Institute during the course of the year, and 120 specimens, including many of the genus *Brachystegia*, were collected for identification by members of the Department. Mr. C. G. Trapnell contributed duplicates of 40 specimens collected in the Northern Province.

171. There have hitherto been no records of any coniferous species indigenous to Northern Rhodesia, but the Ecological Survey has now reported the occurrence, at an altitude around 5,500 feet in Mpika District, of mist-forest relicts containing *Podocarpus* trees. Through the District Commissioner, Isoka, a specimen, which has since been identified as *Podocarpus milanjianus*, was also received in 1938.

C. J. Lewin,
Director of Agriculture.

Mazabuka,
29th March, 1939.